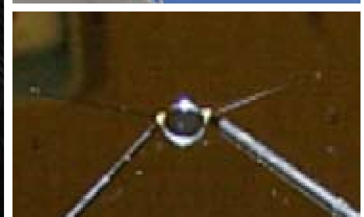
National Aeronautics and Space Administration

technology opportunity

Packaging and Integrating Microphotonic Devices

Carrier structure houses a microphotonic millimeter wave receiver (MMWR)



Packaging and Integrating Optical/Electronic Coupling

Researchers at NASA Glenn Research Center have invented a packaging methodology for integrating a microphotonic millimeter wave receiver (MMWR) using a microphotonic resonate disk on a silicon substrate. Digital information is modulated with an optical beam using a microphotonic resonate disk. This optical beam carrying the digital data signal is coupled into a fiber-optic cable for transmission, providing better signal strength over long distances that is not prone to cross-talk or electromagnetic interface. Because it integrates the optical coupling mechanism onto a silicon substrate, this innovation eliminates the need for bulky equipment to translate the signal. The carrier structure can be made quite small and simple. The technology has wide applicability and can be used with cellular equipment, including pico-cells, local area networks, and "last mile" applications that take signals to the neighborhood level.

Benefits

- **Compact, with better integration**. The microphotonic and optoelectronic devices are packaged, integrated, and interconnected onto a single silicon chip. The total package weighs only a 10th of similar devices on the market, and takes up only a 10th of the space.
- **Economical**. The structure costs less because it requires less equipment and materials and is easy to assemble.
- **Energy efficient**. It uses a 10th of the power needed by its competitors.
- **Adaptable**. It can be used for RF and electrical signals, traditional cellular signals, pico cells and the up-and-coming femto-cell technology; scalable to higher mm-wave frequencies without loss of efficiency.
- **Simpler**. No fiber-to-prism alignment is necessary.

Applications

- National fiber-optic systems
- Wireless Internet
- Cellular phone systems
- Cable and satellite TV systems
- Fiber-to-Home applications
- Wide Area Networks, such as ATM and Sonet
- Large Local Area Networks

Technology Details

How It Works

A lithium niobate resonator disk is integrated onto a silicon chip. A miniaturized laser light source and prisms necessary for coupling and decoupling light also are incorporated, all on a chip size of a few millimeters, with low optical losses.

Light from the laser is split and travels around the perimeter of the resonator disk. The resonator disk transfers the received RF energy onto the light streams traveling around the disk (coupling) and forwards the light streams to prisms, where the modulated and baseline light streams are decoupled. Then, the optical information is forwarded to the output fiber.

Why It Is Better

Wireless information needs to be integrated into a fiber-optic network both cheaply and efficiently. At present, the information has to be demodulated, sent over a copper wire that is slow relative to fiber-optic cable, and then transferred to a laser emitter. The new structure for packaging and integrating microphotonic devices significantly reduces the size of the MMWR. The system integrates all of the components to the chip level, making it cheaper to manufacture and more efficient to operate. It achieves better matching of components, reducing insertion loss and making it easier for the optical signal to be coupled into and extracted from the microdisk resonator. The structure can be adapted to pico-cells, used in urban environments where buildings block signals, and applied to emerging technology, such as femto-cells.

Patents

Patent No. US 7,397,978 B1 was issued July 8, 2008.

Licensing and Partnering Opportunities

NASA invites companies to discuss licensing or partnering opportunities involving this innovative packaging and integration technology for commercial applications.

For More Information

For more information about this and other technology licensing opportunities, please visit:

Technology Transfer and Partnership Office
NASA Glenn Research Center
E-mail: ttp@grc.nasa.gov
Phone: 216–433–3484
http://technology.grc.nasa.gov/

LEW-17694-1
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